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16. ABSTRACT

In May 1976 the U.S. Environmental Protection Agency (EPA) issued a notice of rebuttable presumption against registration (RPAR) of pesticide products containing chlorobenzilate, based on a presumptive cancer risk, in the Federal Register (1976). On June 30, 1978, the EPA published a notice of determination to conclude the RPAR process in the Federal Register (1978) and in 1979 moved to cancel all non-citrus uses of chlorobenzilate, limiting use to citrus crops in California, Texas and Florida. At the time of the EPA decision several methods were available for monitoring CB residues on crops and soil (George et al. 1961, Blinn and Gunther 1963; Gordon et al. 1963). However, methods for human exposure assessment were relatively undeveloped. Subsequent to the EPA decision Brady et al. (1980) published a method whereby urinary levels of CB analyzed as p, p'-dichlorobenzophenone (DBP) could be determined. A study, on a small number of workers, by Levy et al. (1981) suggested that the method was suitable for monitoring citrus field workers for CB exposure.

The objective of the current study was to apply the method developed by Brady et al. (1980) to the monitoring of a large number of CB exposed citrus fieldworkers employed in Florida and Texas, in an effort to assess exposure levels experienced during actual work activities.

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Environmental Contamination and Toxicology

Urinary Chlorobenzilate Residues in Citrus Fieldworkers

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Chlorobenzilate (CB) or ethyl 2-hydroxy-2, 2-di-(p-chlorophenyl)-acetate is formulated as an emulsifiable concentrate and wettable powder and is an acaricide sold under the following trade names: Kop-Mite®, Folbex®, Benzilan®, Acaraben®, and Akar®.

In May 1976 the U.S. Environmental Protection Agency (EPA) issued a notice of rebuttable presumption against registration (RPAR) of pesticide products containing chlorobenzilate, based on a presumptive cancer risk, in the Federal Register (1976). On June 30, 1978, the EPA published a notice of determination to conclude the RPAR process in the Federal Register (1978) and in 1979 moved to cancel all non-citrus uses of chlorobenzilate, limiting use to citrus crops in California, Texas and Florida. At the time of the EPA decision several methods were available for monitoring CB residues on crops and soil (George et al. 1961, Blinn and Gunther 1963; Gordon et al. 1963). However, methods for human exposure assessment were relatively undeveloped. Subsequent to the EPA decision Brady et al. (1980) published a method whereby urinary levels of CB analyzed as p, p'-dichlorobenzophenone (DBP) could be determined. A study, on a small number of workers, by Levy et al. (1981) suggested that the method was suitable for monitoring citrus field workers for CB exposure.

The objective of the current study was to apply the method developed by Brady et al. (1980) to the monitoring of a large number of CB exposed citrus fieldworkers employed in Florida and Texas, in an effort to assess exposure levels experienced during actual work activities.

METHODS

The stratified random sample and worker selection process are described elsewhere (Griffith and Duncan 1985) and will only briefly be discussed here. The two stage design was chosen to obtain information on: citrus use by growers and fieldworkers; alkyl phosphate residue values in the urine of citrus workers; organochlorine residues in the serum of citrus workers; and related

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health effects, e.g., cholinesterase values and pesticide related poisonings. It was necessary to use growers (first stage) since they provided the best access to sample fieldworkers (second stage) in an actual working environment. Growers were stratified by size of acreage, and assessed land value to assure proportionality of the fieldworker sample. During the survey large picker groups were identified, but it was extremely rare to find large numbers of permanent and semi-permanent workers per sampled grower. Thus, non-picker groups were almost always sampled in their entirety, whereas pickers were sampled from a list developed on the sampling site.

Subsequent to the development of the study design, the method was developed by Brady et al. (1980) that permitted the analysis of chlorbenzilate residues in the urine of fieldworkers. Following the development of this method, and late in the conduct of the field survey, a decision was made to monitor citrus fieldworkers for chlorobenzilate residues. Since we were primarily interested in monitoring workers in an occupational setting for CB residues, we elected to sample only those workers employed by growers reporting CB usage in our primary study, who had previously contributed a urine sample for analysis.

In Florida, we identified 20 (10.1%) sampled growers using CB, who had workers providing urine for collection and analysis. From these growers, we randomly selected 11 growers and 30 workers (15 spray season and 15 pickers). The workers provided urine to be analyzed for chlorobenzilate residues. In Texas, we sampled 38 citrus growers and 124 workers. We collected 61 urines for chlorobenzilate analyses following the sample scheme applied in Florida. All analyses were performed using the method of Brady et al. (1980) by the National Pesticide Hazard Assessment Project (NPHAP) staff at Texas Tech University.

The Mann-Whitney U test was used to determine whether the study groups had similar residue values at the .05 level of significance, two-tailed.

RESULTS AND DISCUSSION

The data in Table 1 summarize the distribution of levels of chlorobenzilate residues found in the urine of Florida and Texas citrus fieldworkers. The workers are grouped by state, season of employment, and in one instance, by job category. Spray season workers included applicators, mixers, loaders, and general combination workers. Among the fieldworkers, 75.4%, 86.7%, 60.0% and 100% of the Texas spray, Florida spray, Florida pickers, and Florida applicators, respectively, had detectable urinary chlorobenzilate residues values. The data show a gradient of exposure from low levels in pickers employed during the harvest season when reduced or no application of chlorobenzilate takes place to higher levels

among permanent and semi-permanent workers employed during the spray season. Among all workers urinary values ranged from zero to 63.6 parts per million. When we compared Texas spray season workers to Florida spray season workers we found no statistically significant difference between the groups in urinary chlorobenzilate residue values using the Mann-Whitney U test. However, when we compared Florida spray season workers to Florida harvest season workers, we found that urinary values were statistically significantly higher ($p < .0002$) among the spray season workers. Workers who were clearly identified as applicators (Levy et al. 1981) had larger residue values than the Florida spray season workers ($p < .01$) or the Texas spray season workers ($p < .04$).

Table 1. Observed Urinary Residue Levels Among Florida and Texas Citrus Fieldworkers Exposed to Chlorobenzilate

Citrus Workers	Urinary Residues (ppm)	
Texas spray season workers (n = 61)	Mean	2.670
	SD	9.919
	Range	0.00 - 63.6
Florida spray season workers (n = 15)	Mean	0.304
	SD	0.414
	Range	0.00 - 1.71
Florida harvest season workers (n = 15)	Mean	0.026
	SD	0.026
	Range	0.00 - 0.08
Applicators[a] (n = 3)	Mean	1.543
	SD	1.213
	Range	0.33 - 6.2

[a]Data based on average values for each of three workers observed daily over a two week period (Levy et al. 1981)

The high frequency of positive chlorobenzilate values is not unexpected since the study populations were drawn from workers employed by growers who reported the use of chlorobenzilate on citrus crops. It is to be expected that some workers in the general combination category will not actually be involved in the application of chlorobenzilate, thus, the small percentage of workers without urinary residues.

The data in the current study would appear to support the effectiveness of the method by Brady et al. (1980) as a monitoring tool for estimating chlorobenzilate exposure, and tends to demonstrate

the temporal and occupational gradients that would be expected among exposed workers.

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